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Adachi

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(54) **IMAGE FORMING APPARATUS HAVING IMAGE BEARING MEMBERS**

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G03G 15/01 (2006.01)

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CPC ***G03G 21/0035*** (2013.01); ***G03G 15/0194*** (2013.01)

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See application file for complete search history.

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(57) **ABSTRACT**

An image forming apparatus includes: a first image forming unit including a first image bearing member and a first rotating member configured to rub a surface of the first image bearing member; a second image forming unit including a second image bearing member and a second rotating member configured to rub a surface of the second image bearing member; and a transfer unit configured to convey a sheet between the first image bearing member and the second image bearing member and transfer a developer on the first image bearing member and the second image bearing member, onto the sheet. The first image forming unit is disposed upstream of the second image forming unit in a sheet conveying direction. A force of the second rotating member rubbing the surface of the second image bearing member is less than a force of the first rotating member rubbing the surface of the first image bearing member.

7 Claims, 7 Drawing Sheets

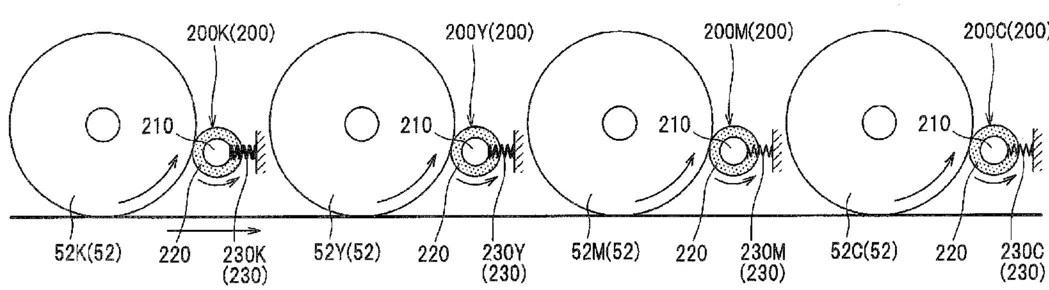
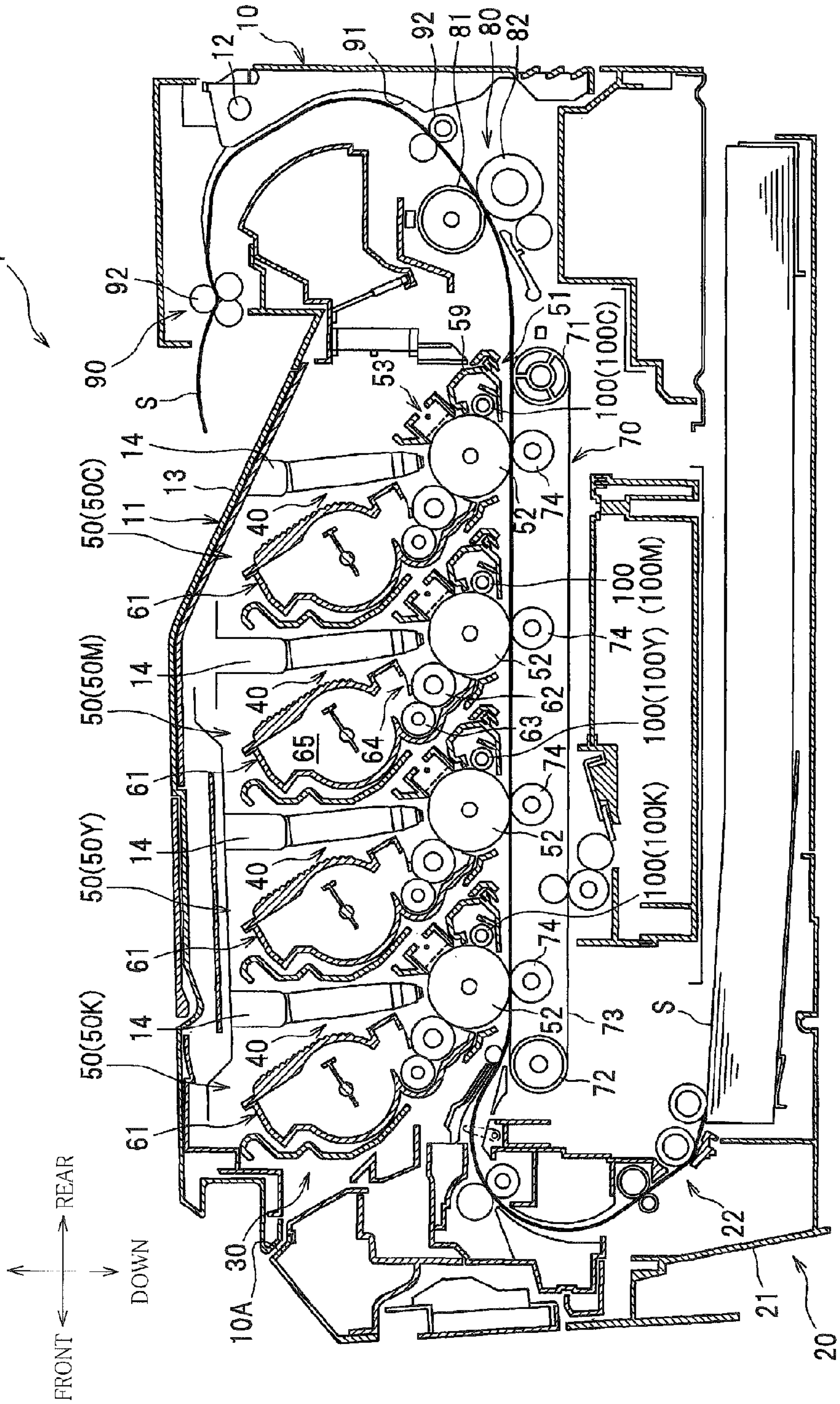


FIG.1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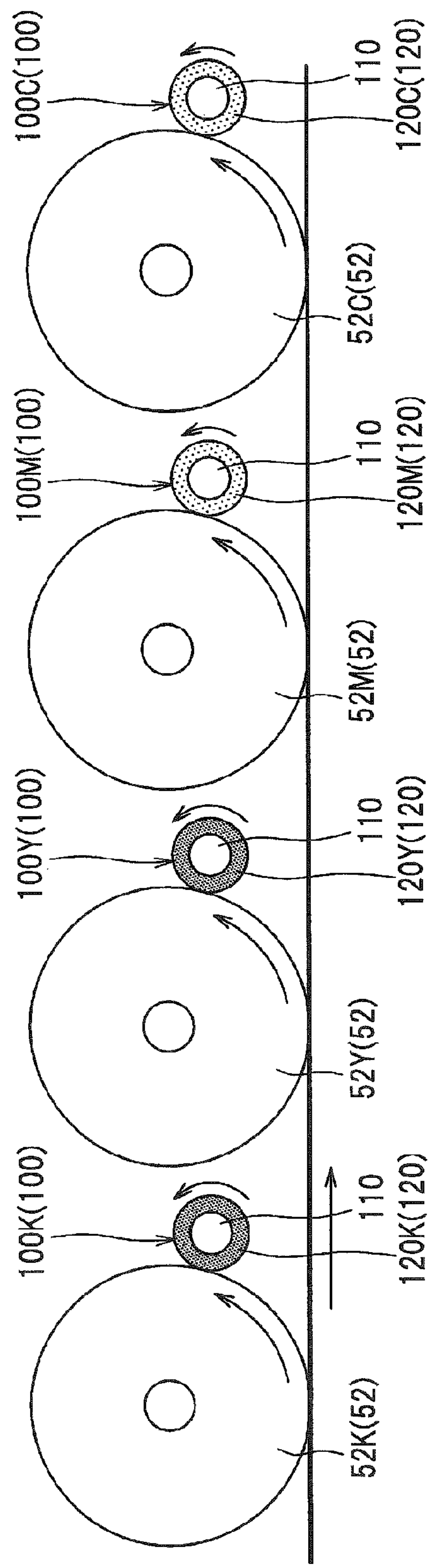
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FIG.2

FIG.3

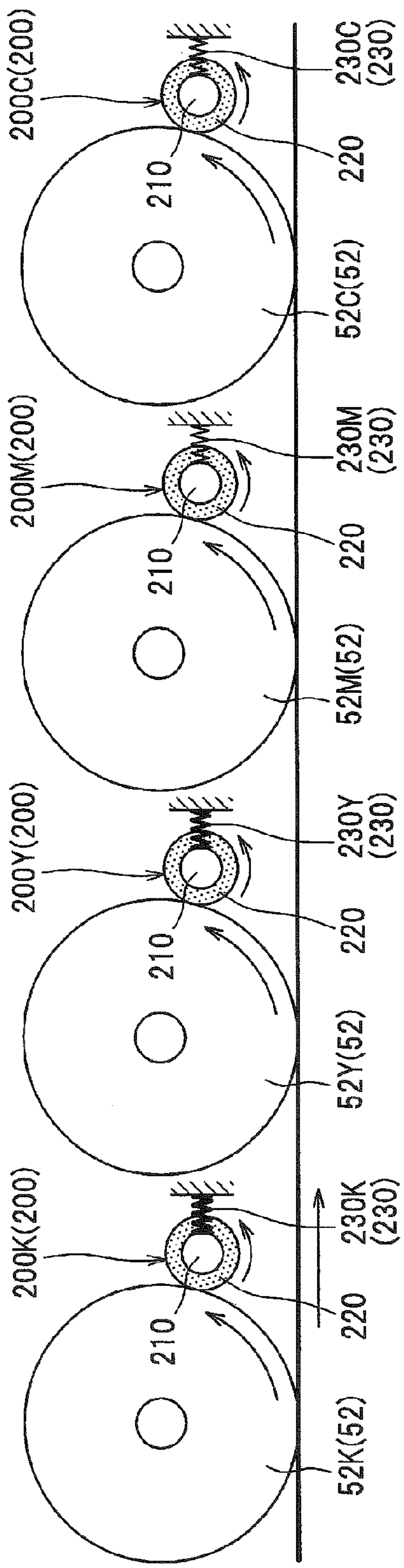
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FIG.4

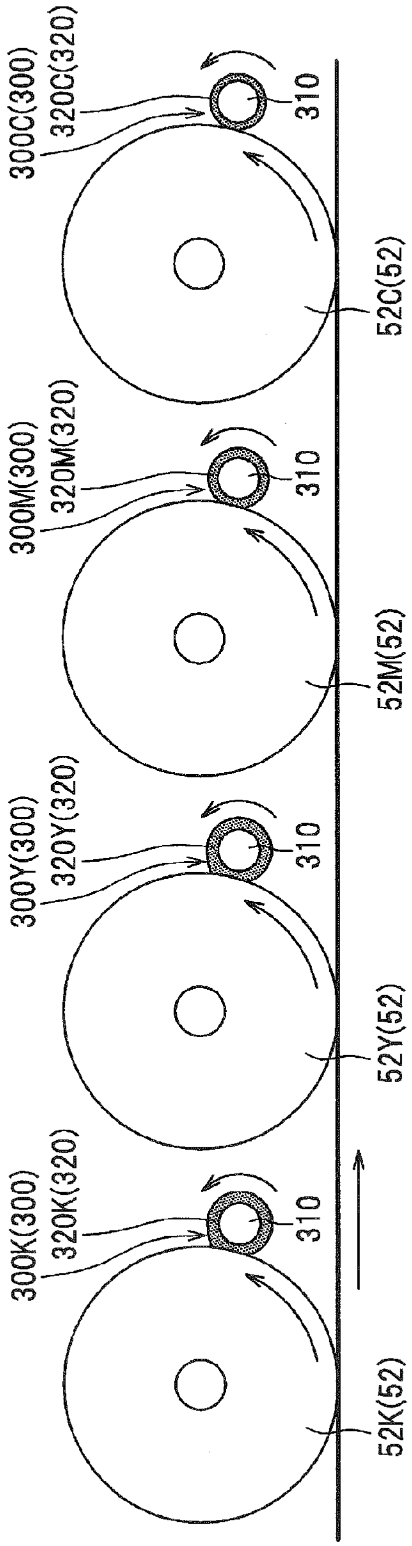
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FIG.5

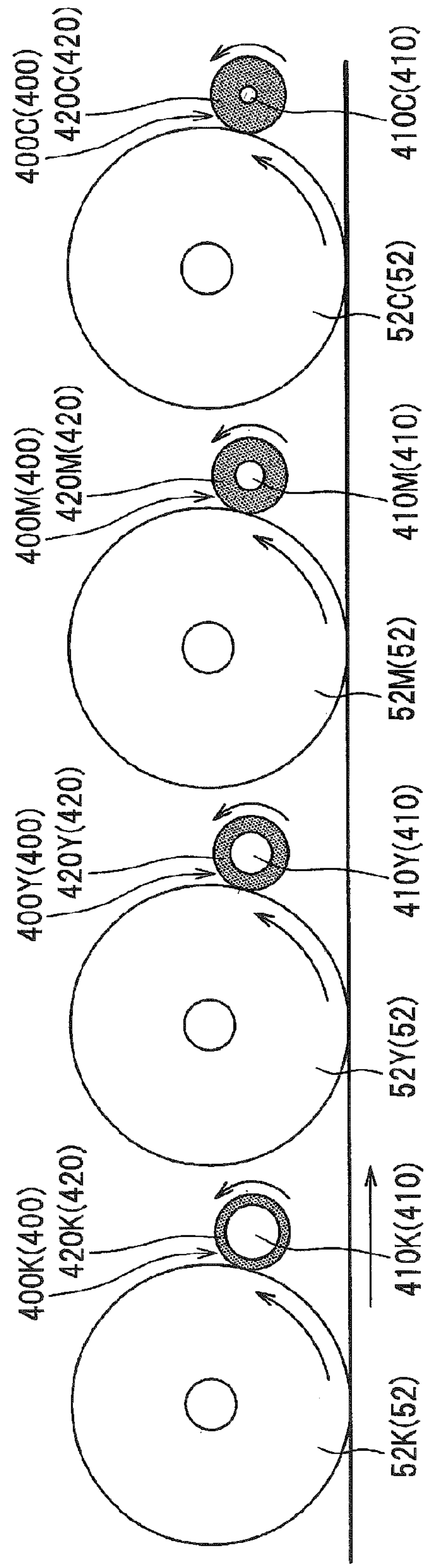
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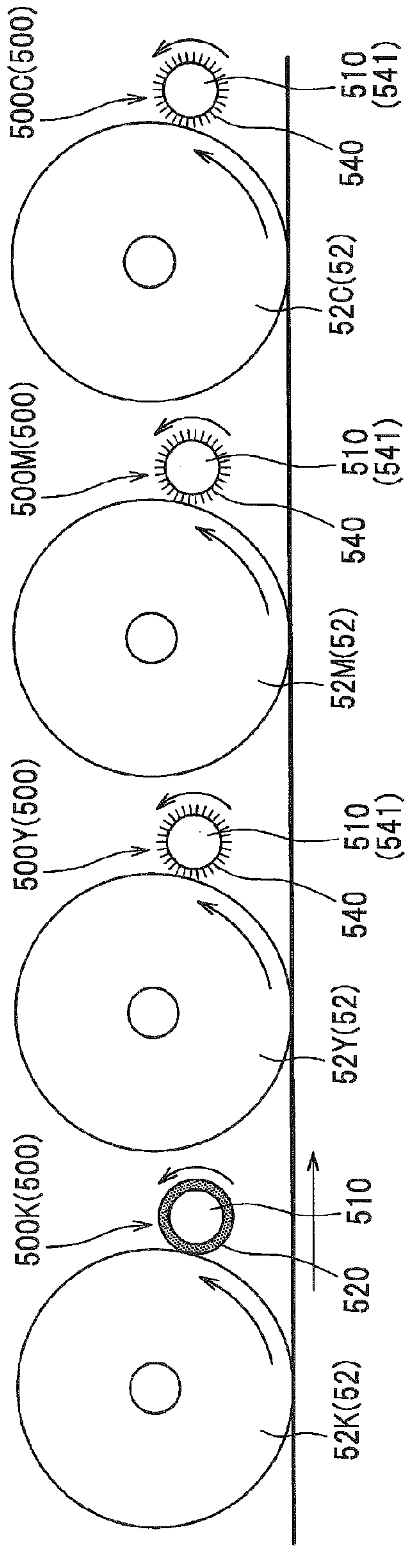
FIG.6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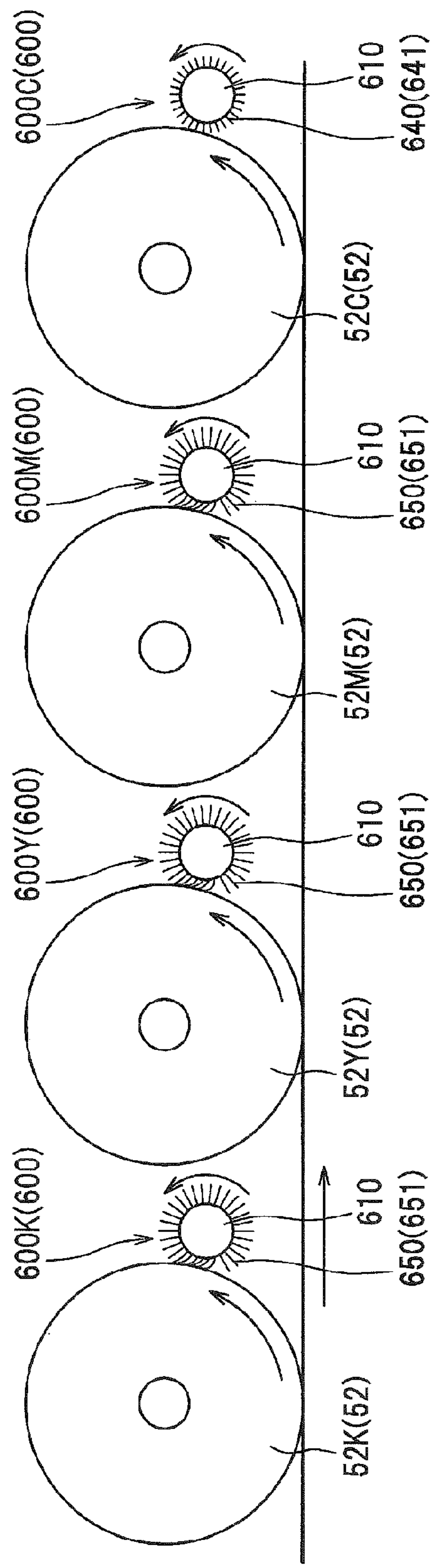
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600K(600)
610
650(651)
52K(52)

FIG. 7

IMAGE FORMING APPARATUS HAVING IMAGE BEARING MEMBERS

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority from Japanese Patent Application No. 2013-146324, which was filed on Jul. 12, 2013, the disclosure of which is herein incorporated by reference in its entirety.

BACKGROUND

1. Technical Field

The present invention relates to an image forming apparatus including a rotating member for rubbing a surface of an image bearing member.

2. Description of the Related Art

There is known a direct tandem image forming apparatus including a plurality of photoconductive drums. This image forming apparatus includes cleaning members capable of contacting the respective photoconductive drums. Each of the cleaning members rubs a surface of a corresponding rotating one of the photoconductive drums to remove foreign matters, e.g., paper dust from the photoconductive drum.

SUMMARY

Incidentally, foreign matters, e.g., paper dust are easily attached to a photoconductive drum located on the most upstream side in a sheet conveying direction at a position near an opening for loading of a sheet. Thus, a force of the cleaning member rubbing the photoconductive drum is preferably made large. However, if forces of all the cleaning members rubbing the respective photoconductive drums are made large, unnecessary loads are applied to the respective photoconductive drums other than the most upstream photoconductive drum. This may inhibit smooth rotation of the photoconductive drums, leading to a printing failure such as banding.

This invention has been developed to provide an image forming apparatus enabling better removal of foreign matters from a surface of an upstream photoconductive drum in a sheet conveying direction and smooth rotation of a downstream photoconductive drum.

The present invention provides an image forming apparatus including: a first image forming unit including a first image bearing member and a first rotating member configured to rub a surface of the first image bearing member; a second image forming unit including a second image bearing member and a second rotating member configured to rub a surface of the second image bearing member; and a transfer unit configured to convey a recording sheet between the first image bearing member and the second image bearing member and transfer a developer on the first image bearing member and the second image bearing member, onto the recording sheet. The first image forming unit is disposed upstream of the second image forming unit in a direction in which the recording sheet is conveyed. A force of the second rotating member rubbing the surface of the second image bearing member is less than a force of the first rotating member rubbing the surface of the first image bearing member.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects, features, advantages, and technical and industrial significance of the present invention will be better

understood by reading the following detailed description of the embodiment of the invention, when considered in connection with the accompanying drawings, in which:

FIG. **1** is a cross-sectional view illustrating a color printer according to one embodiment of the present invention;

FIG. **2** is an enlarged view illustrating four photoconductive drums arranged in a sheet conveying direction and cleaning rollers respectively corresponding to the photoconductive drum;

FIG. **3** is a view illustrating a first modification and corresponding to FIG. **2**;

FIG. **4** is a view illustrating a second modification and corresponding to FIG. **2**;

FIG. **5** is a view illustrating a third modification and corresponding to FIG. **2**;

FIG. **6** is a view illustrating a fourth modification and corresponding to FIG. **2**; and

FIG. **7** is a view illustrating a fifth modification and corresponding to FIG. **2**.

DETAILED DESCRIPTION OF THE EMBODIMENT

Hereinafter, there will be described one embodiment of the present invention by reference to the drawings. In the following description, an overall structure of a color printer **1** as one example of an image forming apparatus will be explained first, and features of the present invention will be thereafter explained.

In the following description, directions are defined with respect to a user using this color printer **1**. That is, a left side, a right side, a back side, and a front side in FIG. **1** are respectively defined as a front side, a rear side, a left side, and a right side. Also, an up and down direction in FIG. **1** are defined as an up and down direction.

<Overall Construction of Color Printer>

As illustrated in FIG. **1**, the color printer **1** includes a body housing **10**, an upper cover **11**, a sheet-supply portion **20** for supplying a sheet S as one example of a recording sheet, an image forming portion **30** for forming an image on the supplied sheet S, and a sheet-output portion **90** for discharging the sheet S on which the image is formed.

The upper cover **11** is provided on an upper portion of the body housing **10** so as to pivot about a pivot shaft **12** located at a rear portion of the body housing **10** such that a front portion of the upper cover **11** moves upward and downward with respect to the body housing **10**. This movement of the upper cover **11** opens and closes an opening **10**A formed in an upper face of the body housing **10**.

The sheet-supply portion **20** includes a sheet-supply tray **21**, provided in a lower portion of the body housing **10**, for storing sheets S, and a sheet-supply mechanism **22** for supplying the sheets S from the sheet-supply tray **21** to the image forming portion **30**. The sheets P in the sheet-supply tray **21** are separated one by one by the sheet-supply mechanism **22** and supplied to the image forming portion **30**.

The image forming portion **30** includes four LED units **40**, four process units **50**, a transfer unit **70**, and a fixing unit **80**.

Each of the LED units **40** is pivotably supported by the upper cover **11** via a holder **14** and disposed on an upper side of a corresponding one of photoconductive drums **52** in a state in which the upper cover **11** is closed. This LED unit **40** illuminates or exposes a surface of the electrically charged photoconductive drum **52** by blinking, based on image data, of a light emitting portion, i.e., an LED, provided at a distal end of the LED unit **40**.

The process units **50** are arranged in parallel in the front and rear direction between the upper cover **11** and the sheet-supply tray **21** so as to be mountable on and removable from the body housing **10** substantially in the up and down direction through the opening **10**A of the body housing **10** which is exposed when the upper cover **11** is open.

The process units **50** are constituted by process units **50**K, **50**Y, **50**M, **50**C respectively containing black toner, yellow toner, magenta toner, and cyan toner and arranged in this order from an upstream side in a sheet conveying direction (in which the sheet S is conveyed) that is directed from a front side to a rear side. In other words, the process unit **50**K for black toner as one example of a first image forming unit is disposed upstream of the process unit **50**C for cyan toner as one example of a second image forming unit in the sheet conveying direction, and the process unit **50**Y for yellow toner as one example of a third image forming unit and the process unit **50**M for magenta toner as one example of a fourth image forming unit are arranged between the process unit **50**K and the process unit **50**C, the process unit **50**Y being disposed upstream of the process unit **50**M. The process unit **50**K for black toner is disposed near an opening which is formed in the image forming portion **30** for loading of the sheet S.

Each of the process units **50** includes a drum unit **51** and a developing unit **61** which is removably mounted on the drum unit **51**.

The drum unit **51** includes a drum frame **59**, the photoconductive drum **52** as one example of an image bearing member provided on the drum frame **59**, a charging unit **53**, and a cleaning roller **100** as one example of a rotating member. The cleaning roller **100** will be explained later. It is noted that rotational speeds of the photoconductive drums **52** of the respective process units **50** are set to be the same.

The developing unit **61** includes a developing roller **62**, a supply roller **63**, a layer-thickness limiting blade **64**, and a toner container **65** for containing toner as one example of a developer which is positively charged.

Each of the developing rollers **62** is provided corresponding to one of the photoconductive drums **52** and bears toner on its surface. This developing roller **62** supplies toner onto the photoconductive drum **52** when the developing roller **62** contacts the photoconductive drum **52** in a state in which a positive developing bias is applied to the developing roller **62**.

The transfer unit **70** is provided between the sheet-supply tray **21** and the process units **50** and includes a drive roller **71**, a driven roller **72**, an endless conveyor belt **73** looped over the drive roller **71** and the driven roller **72**, and the four transfer rollers **74**. An outer surface of the conveyor belt **73** is held in contact with the photoconductive drums **52**, and the conveyor belt **73** conveys the sheet S between the process unit **50**K and the process unit **50**C. The transfer rollers **74** are arranged inside the conveyor belt **73** so as to be opposite the photoconductive drums **52**, with the conveyor belt **73** interposed between the transfer rollers **74** and the photoconductive drums **52**.

The fixing unit **80** is provided at a rear of the process units **50** and the transfer unit **70** and includes a heated roller **81** and a pressure roller **82** disposed so as to opposite the heated roller **81** to press the heated roller **81**.

In the image forming portion **30**, the surface of the photoconductive drum **52** is electrically charged uniformly by the charging unit **53**, and then illuminated and exposed by the LED units **40**, so that an electrostatic latent image based on image data is formed on the photoconductive drum **52**.

The toner in the toner container **65** is supplied to the developing roller **62** via the supply roller **63** and then to a position between the developing roller **62** and the layer-thickness limiting blade **64** and borne on the developing roller **62** as a thin layer having a constant thickness. In this process, the toner is frictionally charged positively between the developing roller **62** and the supply roller **63** and between the developing roller **62** and the layer-thickness limiting blade **64**.

The toner borne on the developing roller **62** is supplied to an exposed region of the photoconductive drum **52**, which forms an visible image from the electrostatic latent image, that is, a toner image is formed on the photoconductive drum **52**. The sheet S supplied from the sheet-supply portion **20** is thereafter conveyed through an area between the photoconductive drums **52** and the conveyor belt **73**, whereby the toner images formed on the respective photoconductive drums **52** are transferred to the sheet S. The sheet S on which the toner images are transferred is conveyed through a position between the heated roller **81** and the pressure roller **82**, whereby the toner images are fixed to the sheet S by heat.

The sheet-output portion **90** includes a sheet output passage **91** for guiding the sheet S conveyed from the fixing unit **80**, and a plurality of conveying rollers **92** for conveying the sheet S. The sheet S on which the toner image is fixed by heat, i.e., the sheet P on which the image is formed is conveyed by the conveying rollers **92** through the sheet output passage **91**, discharged to the outside of the body housing **10**, and placed onto a sheet-output tray **13**.

<Cleaning Rollers>

There will be next explained the cleaning rollers **100**.

As illustrated in FIG. **2**, the cleaning rollers **100** are rotatably provided for the respective photoconductive drums **52**. Each of the cleaning rollers **100** scrubs the surface of the corresponding photoconductive drum **52** to remove foreign matters (such as paper dust and toner) from the photoconductive drum **52**. In use, the cleaning roller **100** and the photoconductive drum **52** are rotated in the same direction, but at an area of the cleaning roller **100** which contacts the photoconductive drum **52**, the traveling direction of the cleaning roller **100** is reverse to the traveling direction of the photoconductive drum **52**.

In the following description, the word "first" is affixed to the members corresponding to black as needed, the word "third" to the members corresponding to yellow, the word "fourth" to the members corresponding to magenta, and the word "second" to the members corresponding to cyan. Furthermore, each of the reference numerals for the components relating to the colors of toner such as the photoconductive drum **52** and the cleaning roller **100** may contain a corresponding one of the signs "K", "Y", "M", and "C" respectively representing black, yellow, magenta, and cyan.

Each of the cleaning rollers **100** is constituted by a roller shaft **110** having a circular cylindrical shape and a roller portion **120** formed of foam rubber and covering the roller shaft **110**. In other words, the surface of the cleaning roller **100** which contacts the photoconductive drum **52** is formed of foam rubber. In the present embodiment, the roller shafts **110** of the respective cleaning rollers **100** have the same construction, and the photoconductive drums **52** also have the same construction. Also, the cleaning rollers **100** have the same outside diameter, and the roller shafts **110** and shafts of the respective photoconductive drum **52** are respectively spaced from each other at the same distance.

Specifically, the first roller portion **120**K is formed of ethylene propylene rubber, and the second roller portion **120**C is formed of silicon rubber. Because of these constructions, the hardness of the second cleaning roller **100**C is less than that of the first cleaning roller **100**K. Accordingly, in a case where the cleaning rollers **100** are in contact with the respective photoconductive drums **52** so as to be compressed by the same amount, the resilience of the second roller portion **120**C is less than that of the first roller portion **120**K. That is, a pressure at which the second cleaning roller **100**C is in contact with the second photoconductive drum **52**C is less than a pressure at which the first cleaning roller **100**K is in contact with the first photoconductive drum **52**K.

The third roller portion **120**Y is formed of ethylene propylene rubber like the first roller portion **120**K, and the fourth roller portion **120**M is formed of silicon rubber like the second roller portion **120**C. Accordingly, a pressure at which the third cleaning roller **100**Y is in contact with the third photoconductive drum **52**Y is equal to the pressure at which the first cleaning roller **100**K is in contact with the first photoconductive drum **52**K, and a pressure at which the fourth cleaning roller **100**M is in contact with the fourth photoconductive drum **52**M is equal to the pressure at which the second cleaning roller **100**C is in contact with the second photoconductive drum **52**C.

In the present embodiment, the rotational speed of the second cleaning roller **100**C is set to be lower than the rotational speed of the first cleaning roller **100**K. Accordingly, the difference in rotational speed between the second cleaning roller **100**C and the second photoconductive drum **52**C is smaller than the difference in rotational speed between the first cleaning roller **100**K and the first photoconductive drum **52**K.

The rotational speed of the third cleaning roller **100**Y is set to be equal to that of the first cleaning roller **100**K, and the rotational speed of the fourth cleaning roller **100**M is set to be equal to that of the second cleaning roller **100**C. Accordingly, a difference in rotational speed between the third cleaning roller **100**Y and the third photoconductive drum **52**Y is equal to the difference in rotational speed between the first cleaning roller **100**K and the first photoconductive drum **52**K, and a difference in rotational speed between the fourth cleaning roller **100**M and the fourth photoconductive drum **52**M is equal to the difference in rotational speed between the second cleaning roller **100**C and the second photoconductive drum **52**C.

To make the rotational speeds of the cleaning rollers **100** different from one another, gear ratios of gear trains for driving the respective cleaning rollers **100** are made different from one another, for example.

There will be next explained operations and effects of the color printer **1** including the cleaning rollers **100** having the constructions described above.

The cleaning rollers **100** are rotated in the same direction as the photoconductive drums **52** while scrubbing the surfaces of the respective photoconductive drums **52**. Here, the cleaning roller **100** and the surface of the photoconductive drum **52** scrub each other at their respective contact portions, so that foreign matters (such as paper dust and toner) on the surface of the photoconductive drum **52** are removed by the cleaning roller **100**.

Incidentally, foreign matters, e.g., paper dust are easily attached in particular to the first photoconductive drum **52**K located near the opening for loading of the sheet S on the most upstream side in the sheet conveying direction among the photoconductive drums **52**. Thus, a force of the first cleaning roller **100**K rubbing the first photoconductive drum **52**K is preferably made larger. In this case, if a force of the second cleaning roller **100**C rubbing the second photoconductive drum **52**C is also made large, an unnecessary load is applied to the second photoconductive drum **52**C which is located on the most downstream side among the photoconductive drums **52** and to which foreign matters, e.g., paper dust are less attached when compared with the first photoconductive drum **52**K. This unnecessary load inhibits smooth rotation of the second photoconductive drum **52**C, leading to a printing failure such as banding.

In the present embodiment, however, the difference in rotational speed between the second cleaning roller **100**C and the second photoconductive drum **52**C is less than the difference in rotational speed between the first cleaning roller **100**K and the first photoconductive drum **52**K. Thus, a frictional force by which the second cleaning roller **100**C scrubs the second photoconductive drum **52**C is smaller than a frictional force by which the first cleaning roller **100**K scrubs the first photoconductive drum **52**K. That is, since the force of the second cleaning roller **100**C rubbing the surface of the second photoconductive drum **52**C is smaller than the force of the first cleaning roller **100**K rubbing the surface of the first photoconductive drum **52**K, a load applied from the second cleaning roller **100**C to the second photoconductive drum **52**C is smaller than a load applied from the first cleaning roller **100**K to the first photoconductive drum **52**K. Accordingly, foreign matters can be reliably removed from the surface of the first photoconductive drum **52**K, and the second photoconductive drum **52**C can be rotated smoothly.

It is noted that the above-described difference in rotational speed can be set as needed. While the cleaning roller **100** and the photoconductive drum **52** are rotated in the same direction in the present embodiment, in a case where the difference in rotational speed between the second cleaning roller **100**C and the second photoconductive drum **52**C is less than the difference in rotational speed between the first cleaning roller **100**K and the first photoconductive drum **52**K, at least one of the cleaning rollers **100** may be rotated in a direction reverse to the rotational direction of the photoconductive drum **52** (that is, the traveling direction of the cleaning rollers **100** coincides with the traveling direction of the photoconductive drum **52**). Also, the rotational speed of each cleaning roller **100** may be set as needed as long as the above-described conditions are satisfied. For example, in a case where the rotational direction of the cleaning roller **100** and that of the photoconductive drum **52** are reverse to each other, the rotational speed of each cleaning roller **100** may be made greater than the rotational speed of the photoconductive drum **52**.

The pressure at which the second cleaning roller **100**C is in contact with the second photoconductive drum **52**C is less than the pressure at which the first cleaning roller **100**K is in contact with the first photoconductive drum **52**K. Accordingly, the force of the second cleaning roller **100**C rubbing the surface of the second photoconductive drum **52**C is smaller than the force of the first cleaning roller **100**K rubbing the surface of the first photoconductive drum **52**K, enabling more smooth rotation of the second photoconductive drum **52**C.

Incidentally, foreign matters, e.g., paper dust are attached to the third photoconductive drum **52**Y located next to the most upstream first photoconductive drum **52**K in the sheet conveying direction at the second highest frequency. Thus, a force of the third cleaning roller **100**Y rubbing the third photoconductive drum **52**Y is preferably set to be relatively large. In the present embodiment, the contact pressure and the rotational speed of the third cleaning roller **100**Y are equal to those of the first cleaning roller **100**K, so that the magnitude of the force of the third cleaning roller **100**Y rubbing the third photoconductive drum **52**Y is equal to that of the force of the first cleaning roller **100**K rubbing the first photoconductive drum **52**K. Accordingly, the third photoconductive drum **52**Y can be rubbed by a force identical to the force by which the first photoconductive drum **52**K is rubbed.

While the embodiment of the present invention has been described above, it is to be understood that the invention is not limited to the details of the illustrated embodiment, but may be embodied with various changes and modifications, which may occur to those skilled in the art, without departing from the spirit and scope of the invention.

In the above-described embodiment, the difference in rotational speed between the second cleaning roller **100**C and the second photoconductive drum **52**C is less than the difference in rotational speed between the first cleaning roller **100**K and the first photoconductive drum **52**K. However, these differences in rotational speed may be equal to each other as long as the force of the second cleaning roller **100**C rubbing the second photoconductive drum **52**C is smaller than the force of the first cleaning roller **100**K rubbing the first photoconductive drum **52**K.

While the material of the first roller portion **120**K and that of the second roller portion **120**C are different from each other in the above-described embodiment, these roller portions may be formed of the same material as long as the force of the second cleaning roller **100**C rubbing the second photoconductive drum **52**C is smaller than the force of the first cleaning roller **100**K rubbing the first photoconductive drum **52**K.

FIG. **3** illustrates one example of a configuration in which the cleaning rollers are rotated at the same speed, and the roller portions are formed of the same material. In FIG. **3**, compression springs **230** having different urging forces are provided.

In this configuration, each of cleaning rollers **200** is constituted by a roller shaft **210** and a roller portion **220**.

The compression springs **230** respectively urge components such as bearings of the cleaning rollers **200** to the photoconductive drums **52**, and urging forces of the respective compression springs **230** are partly different from one another.

Specifically, the first compression spring **230**K as one example of a first urging member has the largest urging force among the compression springs **230**, with the third compression spring **230**Y and the fourth compression spring **230**M following in that order. The second compression spring **230**C as one example of a second urging member has the same construction as the fourth compression spring **230**M.

In this configuration, the first cleaning roller **200**K has the highest contact pressure among the cleaning rollers **200**, with the third cleaning roller **200**Y and the fourth cleaning roller **200**M following in that order. Also, the contact pressure of the second cleaning roller **200**C is equal to that of the fourth cleaning roller **200**M. It is noted that each of the third cleaning roller **200**Y and the fourth cleaning roller **200**M can be considered to as a second rotating member. The compression spring **230** is used as the urging member, but the present invention is not limited to this configuration, and the compression spring **230** may be a torsion spring, for example.

FIG. **4** illustrates another example of the configuration in which the cleaning rollers are rotated at the same speed, and the roller portions are formed of the same material. In FIG. **4**, roller portions **320** have different thicknesses.

In this configuration, each of cleaning rollers **300** is constituted by a roller shaft **310** and the roller portion **320**, and the roller shafts **310** have the same construction. Also, distances between axes of the photoconductive drums **52** and axes of the respective roller shafts **310** are also coincide with each other.

The first roller portion **320**K and the third roller portion **320**Y have the largest thickness (the same thickness) among the roller portions **320**, with the fourth roller portion **320**M and the second roller portion **320**C following in that order. In this configuration, the first roller portion **320**K and the third roller portion **320**Y have the largest amount of compression among the roller portions **320** when each pressed by the corresponding roller shaft **310** and the photoconductive drum **52**, with the fourth roller portion **320**M and the second roller portion **320**C following in that order.

In this configuration, the first cleaning roller **300**K and the third cleaning roller **300**Y have the largest contact pressure among the cleaning rollers **300**, with the fourth cleaning roller **300**M and the second cleaning roller **300**C following in that order.

As another example different from those illustrated in FIGS. **3** and **4**, FIG. **5** illustrates a configuration in which roller portions **420** formed of foam rubber have different thicknesses.

In this configuration, each of cleaning rollers **400** is constituted by a roller shaft **410** and the roller portion **420**. The roller shaft **410**K has the largest diameter among the roller shafts **410**, with the roller shafts **410**Y, **410**M, **410**C following in that order. A roller portion **420**K has the smallest thickness among the roller portions **420**, with the roller portions **420**Y, **420**M, **420**C following in that order. The cleaning rollers **400** have the same outside diameter.

Increase in the thickness of the roller portion **420** decreases elastic coefficient. Accordingly, in a case where the cleaning rollers **400** are respectively held in contact with the photoconductive drums **52** by the same amount of compression, the first roller portion **420**K presses the corresponding photoconductive drum **52** back by the largest force among the cleaning rollers **400**, with the third roller portion **420**Y, the fourth roller portion **420**M, and the second roller portion **420**C following in that order. Also, the first roller shaft **410**K has the largest diameter and its outer circumferential surface is spaced apart from the corresponding photoconductive drum **52** at the smallest distance among the roller shafts **410**, with the third roller shaft **410**Y, the fourth roller shaft **410**M, and the second roller shaft **410**C following in that order. Thus, the force of the first cleaning roller **400**K rubbing the corresponding photoconductive drum **52** is affected by the corresponding roller shaft **410** by the largest amount among the cleaning rollers **400**, with the third cleaning roller **400**Y, the fourth cleaning roller **400**M, and the second cleaning roller **400**C following in that order. Accordingly, the first cleaning roller **400**K is set to have the largest contact pressure among the cleaning rollers **400**, with the third cleaning roller **400**Y, the fourth cleaning roller **400**M, and the second cleaning roller **400**C following in that order.

The surface of the second cleaning roller **100**C is formed of the foam rubber in the above-described embodiment, but the present invention is not limited to this configuration. For example, the second cleaning roller **100**C may be constituted by a brush roller as illustrated in FIG. **6**. It is noted that cleaning rollers **500** are set to be rotated at the same speed.

In this configuration, the first cleaning roller **500**K is constituted by a roller shaft **510** and a roller portion **520** formed of foam rubber.

Each of the second cleaning rollers **500**Y, **500**M, **500**C is a brush roller constituted by the roller shaft **510** and a brush layer **541** with a plurality of fibers **540** held on an outer circumferential surface of the roller shaft **510**. In this configuration, each of the second cleaning rollers **500**Y, **500**M, **500**C can remove foreign matters, e.g., paper dust from the surface of the second photoconductive drum **52**C such that the fibers **540** stroke the surface of the second photoconductive drum **52**C.

Here, each of the second cleaning rollers **500**Y, **500**M, **500**C constituted by the brush rollers is smaller than the first cleaning roller **500**K formed of the foam rubber in force for rubbing the corresponding photoconductive drum **52**, and consequently a smaller load is applied to the photoconductive drum **52** by each of the second cleaning rollers **500**Y, **500**M, **500**C, whereby the second photoconductive drum **52**C can be rotated smoothly. Also, the brush roller is less expansive than the roller formed of the foam rubber, resulting in reduced cost.

Only the first cleaning roller **500**K has the foam rubber in FIG. **6**, but the present invention is not limited to this configuration. For example, as illustrated in FIG. **7**, all cleaning rollers **600**K-**600**C may be constituted by brush rollers. It is noted that the cleaning rollers **600** are set to be rotated at the same speed.

In this configuration, each of the first cleaning rollers **600**K, **600**Y, **600**M is constituted by a roller shaft **610** and a brush layer **651** with a plurality of fibers **650** held on an outer circumferential surface of the roller shaft **610**, and the second cleaning roller **600**C is constituted by a roller shaft **610** and a brush layer **641** with a plurality of fibers **640** held on an outer circumferential surface of the roller shaft **610**. Each fiber **650** of the first cleaning rollers **600**K, **600**Y, **600**M is longer than each fiber **640** of the second cleaning roller **600**C, so that the area of contact of each fiber **640** with the second cleaning roller **600**C is smaller than the area of contact of each fiber **650** with the corresponding one of the first cleaning rollers **600**K, **600**Y, **600**M. Accordingly, the force of the second cleaning roller **600**C rubbing the corresponding photoconductive drum **52** is smaller than the force of each of the first cleaning rollers **600**K, **600**Y, **600**M rubbing the corresponding photoconductive drum **52**.

In the embodiment, the thickness of the fiber may be changed to make the force of each cleaning roller rubbing the corresponding photoconductive drum **52** different from each other.

In the above-described embodiment, the photoconductive drum **52** is used as one example of the image bearing member, but the present invention is not limited to this configuration. For example, a photoconductor belt may be used as the image bearing member.

While the present invention is applied to the color printer **1** in the above-described embodiment, the present invention may be applied to other image forming apparatuses such as a copying machine and a multifunction peripheral.

While the sheet S such as a thick paper sheet, a postcard, and a thin paper sheet is used as the recording sheet in the above-described embodiment, other types of sheets such as an OHP sheet may be used as the recording sheet.

What is claimed is:

1. An image forming apparatus, comprising:

a first image forming unit comprising a first image bearing member, a first cleaning roller comprising a first roller shaft and a first rotating member configured to rotate about the first roller shaft and configured to rub a surface of the first image bearing member, and a first urging spring configured to directly urge the first roller shaft of the first cleaning roller in a direction directed from the first roller shaft toward the first image bearing member;

a second image forming unit comprising a second image bearing member, a second cleaning roller comprising a second roller shaft and a second rotating member configured to rotate about the second roller shaft and configured to rub a surface of the second image bearing member, and a second urging spring configured to directly urge the second roller shaft of the second cleaning roller in a direction directed from the second roller shaft toward the second image bearing member; and

a transfer unit configured to transfer a developer on the first image bearing member and the second image bearing member onto a recording sheet,

wherein the first image forming unit is disposed upstream of the second image forming unit in a direction in which the recording sheet is conveyed, and

wherein a contact pressure, caused by an urged force of the second roller shaft of the second cleaning roller, at which the second rotating member is in contact with the second image bearing member is less than a contact pressure caused by an urged force of the first roller shaft of the first cleaning roller, at which the first rotating member is in contact with the first image bearing member.

2. The image forming apparatus according to claim **1**, wherein a difference in rotational speed between the second rotating member and the second image bearing member is less than a difference in rotational speed between the first rotating member and the first image bearing member.

3. The image forming apparatus according to claim **1**, wherein a surface of the first rotating member and a surface of the second rotating member are formed of foam rubber.

4. The image forming apparatus according to claim **3**, wherein a hardness of the second rotating member is less than that of the first rotating member.

5. The image forming apparatus according to claim **4**,

wherein the surface of the first rotating member is formed of ethylene propylene rubber, and

wherein the surface of the second rotating member is formed of silicon rubber.

6. The image forming apparatus according to claim **1**, wherein the second rotating member is a brush roller.

7. The image forming apparatus according to claim **1**, further comprising a third image forming unit and a fourth image forming unit between the first image forming unit and the second image forming unit,

wherein the third image forming unit comprises a third image bearing member, a third cleaning roller comprising a third roller shaft and a third rotating member configured to rotate about the third roller shaft and configured to rub a surface of the third image bearing member, and a third urging spring configured to directly urge the third roller shaft of the third cleaning roller in a direction directed from the third roller shaft toward the third image bearing member, and the third image forming unit is disposed upstream of the fourth image forming unit in the conveying direction, and

wherein a contact pressure, caused by an urged force of the third roller shaft of the third cleaning roller, at which the third rotating member is in contact with the third image bearing member is equal to the contact pressure at which the first rotating member is in contact with the first image bearing member.

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